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## HIGH-SPEED TRAIN ALIGNMENT ALTERNATIVES AND POTENTIAL STATION LOCATION OPTIONS

Informed by previous studies and the scoping process, the California High Speed Rail Authority (Authority) and the Federal Railroad Administration (FRA) have evaluated potential High Speed Train (HST) corridor alignments alternatives and station location options and defined those that best met the project purpose, which is to provide a reliable high-speed electrified train system that links the major Bay Area cities to the Central Valley, Sacramento, and Southern California, and that delivers predictable and consistent travel times. Further objectives are to provide an interface between the HST and major commercial airports, mass transit, and the highway network, and to relieve capacity constraints of the existing transportation system in a manner sensitive to and protective of the Bay Area's and California's unique natural resources. Based on the HST Alternative selected in the Final Program Environmental Impact Report/Environmental Impact Statement (EIR/EIS) for the Proposed California HST System (Authority and FRA, 2005), reasonable and feasible alignment and station alternatives in the Bay Area to Central Valley corridor have been identified for analysis in this Program EIR/EIS. These general HST alignment options and potential station locations are shown in Figure 1.

### Performance Criteria

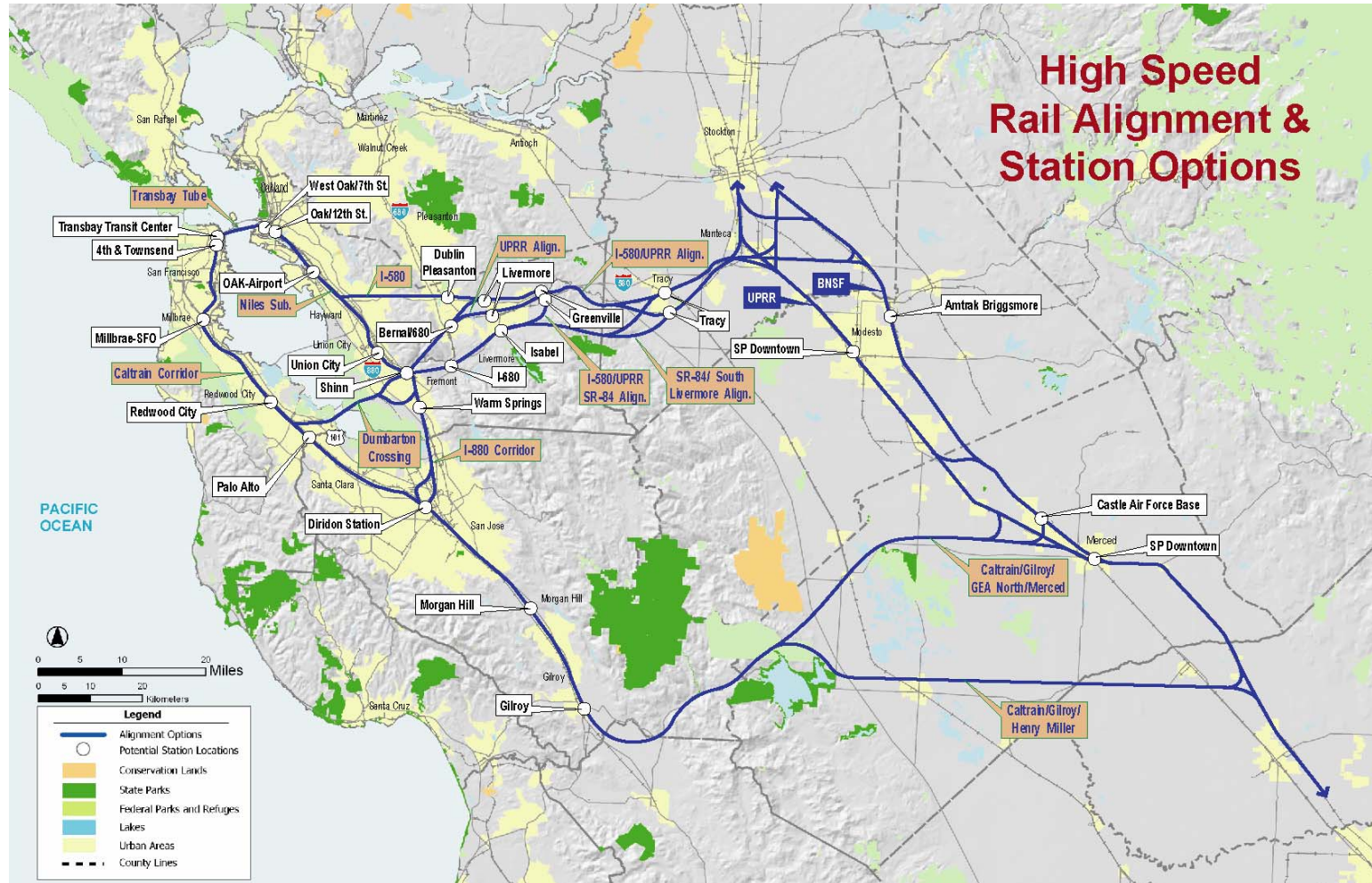
The Authority and the FRA previously defined performance criteria for the HST in the Program EIR/EIS for the HST system (Authority and FRA, 2005), drawing upon many prior feasibility and corridor evaluation studies. To meet the travel time and service quality goals, the statewide HST system will be capable of speeds in excess of 200 mph (320 kph) on fully grade-separated tracks with state-of-the-art safety, signaling, and automated train control systems. These performance criteria are summarized in Table 1.

To satisfy the travel time, service quality, and expected ridership (representative demand) developed for the Authority's June 2000 Business Plan, and accounting for the general characteristics of the corridors considered, the conceptual service plan must provide a wide variety of service options. A mix of express, semi-express, local, and regional trains would serve both intercity passengers and long-distance commuters. In order for HST service to be economically viable, train operations must be frequent and efficient.

The safe operation of the HST system is of the utmost importance. To this end, the HST would be fully grade-separated and would have fully access-controlled guideway with intrusion monitoring systems. This means that the HST infrastructure (e.g., mainline tracks and maintenance and storage facilities) would be designed to prevent access by unauthorized vehicles, persons, animals, and objects. The capital cost estimates include allowances for appropriate barriers (fences and walls), state-of-the-art communication, access-control, and monitoring and detection systems. All aspects of the HST system would conform to the latest Federal requirements regarding transportation security as developed and implemented. The HST trainsets (train cars) would be pressure sealed to maintain passenger comfort regardless of aerodynamic changes along the line.

The Authority does not anticipate the construction of a separate power source for the HST. The Authority's previous analysis concluded that sufficient electricity is expected to be available to power the proposed HST, as segments are constructed and begin operating, since commercially provided power generation is expected to grow to meet increased demand in the state and the power needs of the proposed HST system represent a small part of that overall increase in demand.

**Figure 1: Alignment Alternatives and Station Location Options**



**Table 1**  
**HST Performance Criteria**

Category	Criteria
System Design Criteria <sup>1</sup>	Electric propulsion system. Fully grade-separated guideway. Fully access-controlled guideway with intrusion monitoring systems. Track geometry must maintain passenger comfort criteria (smoothness of ride, lateral acceleration less than 0.1 g).
System Capabilities	All-weather/all-season operation. Capable of sustained vertical gradient of 3.5% without considerable degradation in performance. Capable of operating parcel and special freight service as a secondary use. Capable of safe, comfortable, and efficient operation at speeds over 200 mph. Capable of maintaining operations at 3-minute headways. Capable of traveling from San Francisco to Los Angeles in approximately 2.5 hrs. Equipped with high-capacity and redundant communications systems capable of supporting fully automatic train control.
System Capacity	Fully dual track mainline with off-line station stopping tracks. Capable of accommodating a wide range of passenger demand (up to 26,000 passengers per hour per direction). Capable of accommodating normal maintenance activities without disruption to daily operations.
Level of Service	Capable of accommodating a wide range of service types (express, semi-express/limited stop, and local).

The HST system could be used to carry small packages, parcels, letters, or any other freight that would not exceed typical passenger loads. This service could be provided either in specialized freight cars on passenger trains or on dedicated lightweight freight trains. A high-speed freight service might also be provided on specialized, medium-weight freight trains. This specialized freight equipment would have limited axle loads (19 metric tons compared to the conventional freight standard of 27 metric tons per axle), would operate at speeds of up to 125 mph (200 kph), and would be scheduled at night to avoid conflict with passenger or maintenance operations.

### Description of High-Speed Train Technology

The selected HST technology (Authority and FRA, 2005) consists of steel-wheel-on-steel-rail trains capable of meeting the Authority's performance criteria (as summarized in Table 1) that would be able to share tracks at reduced speeds with other compatible services. All existing systems with this very high-speed capability use electric propulsion. This state-of-the-art, high-speed, steel-wheel-on-steel-rail technology would operate in the majority of the statewide system in dedicated (exclusive track) configuration. However, where the construction of new separate HST infrastructure would be infeasible, shared-track operations would use improved rail infrastructure and electrical propulsion. Shared-use corridors would be limited to sections of the statewide system with extensive urban constraints.

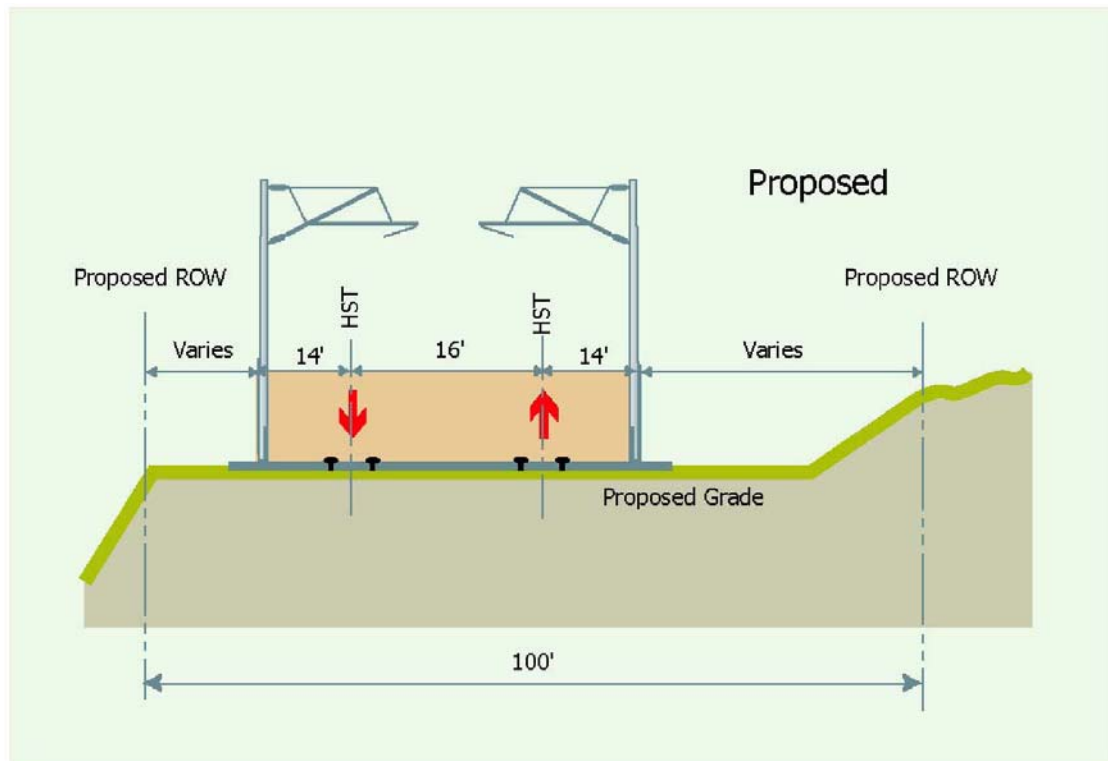
<sup>1</sup> Engineering Criteria, January 2004

Shared-use corridors would meet the following general criteria in addition to the performance criteria.

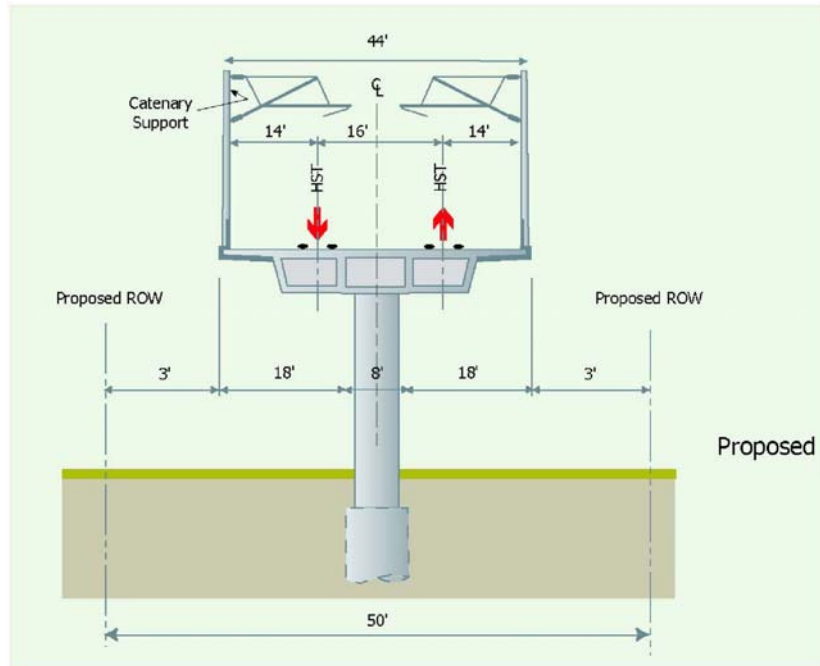
- Uniform control/signal system.
- Four tracks at stations (to allow for through/express services and local stopping patterns).
- May require three to six mainline tracks (depending on capacity requirements and combination of HST and other services).
- Physical or temporal separation from conventional freight traffic.

Using the selected technology, the HST system would be constructed with consistent dual track in a variety of construction sections (e.g., at grade, elevated structure, tunnel), as appropriate for the constraints of each specific section. These typical construction sections are illustrated in Figures 2, 3, and 4.

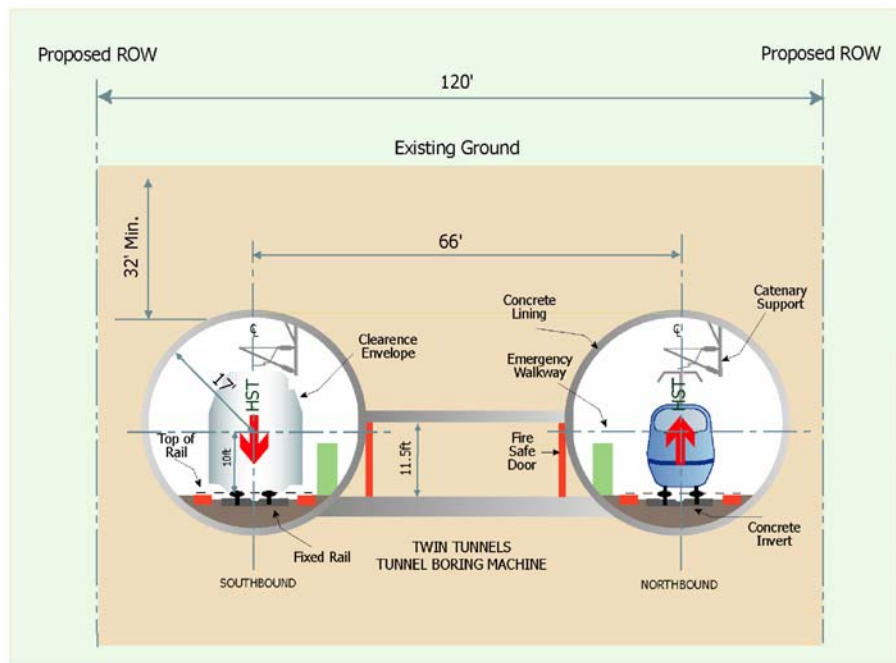
**Figure 2**  
**At-Grade Section**



**Figure 3**  
**Elevated Structure**



**Figure 4**  
**Twin Tunnels**





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## Alternative HST Alignment and Station Alternatives

The Authority has developed a range of potential HST Alternative alignments and station location options through review of the Program EIR/EIS for the HST system (Authority and FRA, 2005), previous studies, and scoping comments, as well as an engineering evaluation of alignment alternatives and station location options within the most promising potential routes through the Bay Area to Central Valley corridor. This range of HST alignment alternatives and station location options have been evaluated to identify practicable alternatives and options that best meet the purpose and need of the proposed action.

Proposed HST alignment alternatives are generally configured along or adjacent to existing rail transportation facilities or highways instead of creating new transportation corridors. Previous corridor evaluations and the extensive analysis in the Program EIR/EIS for the HST system (Authority and FRA, 2005) have consistently shown a potential for fewer substantial environmental impacts along existing highway and rail facilities than on new alignments through both developed and undeveloped areas. Although increasing the overall width of existing facilities could have similar potential impact on the amount of land disturbed as creating new facilities, creating new facilities would also introduce potential incompatibility and severance issues in both urban communities and rural settings (farmlands, open spaces).

The general station locations described in this section represent the most likely sites based on current knowledge, consistent with the objective to serve the state's major population centers. There is a critical tradeoff between accessibility of the system to potential passengers and the resulting HST travel times (i.e., more closely spaced stations will lengthen the travel times for local service as well as express services). The station locations shown here are spaced approximately 50 mi (80 km) apart in rural areas and 15 mi (24 km) apart in the metropolitan areas. Additional or more closely spaced stations would negatively affect travel times and the ability to operate both express and local services.

Several key factors were considered in identifying potential stations, including: speed, cost, local access times, potential connections with other modes of transportation, ridership potential, and the distribution of population and major destinations along the route. The ultimate locations and configurations of stations would be determined during future project-level environmental review. The alignment alternatives and station location options are described below.

Included as part of the Alignments is the consideration of regional "overlay" services using the high-speed statewide infrastructure with additional investments in facilities (e.g., non-HST regional rail stations along the HST alignment) and compatible rolling stock necessary to support all of the proposed services. These "regional rail" stations would be designed in a manner that would not introduce delays in HST schedules and at the same time would allow for more regionally-oriented long-distance commuter services. This could involve four and/or six track stations, for example. If designed appropriately, regional rail service could be provided at the potential HST stations or at locations not shown on Figure 1. The regional rail stations could be less distance apart than the HST stations.

### Bay Area to Central Valley Options Carried Forward

The following alignment alternatives and stations location options are analyzed in this Bay Area to Central Valley HST Program EIR/EIS (see Figure 1). A number of operating scenarios for combinations of terminus stations will be investigated with options ranging from one to three (San Francisco, Oakland, and San Jose) termini for direct HST service to the Bay Area.

**San Francisco to San Jose:** The alignment alternatives and station location options in this segment carried forward for further consideration are illustrated in Figure 1 and discussed below.

- Caltrain Corridor (Shared-Use Four-Track Alignment): From San Francisco, this alignment would follow south along the Caltrain rail alignment to San Jose. This option assumes that the HST system would share tracks with Caltrain commuter trains. The entire alignment would be grade separated. Station options would include a station in the lower level of the proposed new Transbay Terminal in San Francisco, or station at 4th and King Streets, a station in Millbrae to serve SFO, and a station in either Redwood City or Palo Alto.

For HST service on the San Francisco Peninsula, sharing track with Caltrain is the only realistic alternative for a direct link to San Francisco because of the lack of sufficient available right-of-way along the Peninsula and the high cost of acquiring additional right-of-way. Sharing track with Caltrain requires use of steel-wheel-on-rail HST technology if the HST system is to serve San Francisco without a transfer. Unlike the dedicated (exclusive guideway) options, which would require tall elevated structures along the Caltrain or US-101 rights-of-way and extensive purchases of additional right-of-way, the Caltrain corridor shared-use option would take advantage of the existing rail infrastructure and would provide service mostly at grade.

#### Station Locations Carried Forward

##### *San Francisco:*

- Transbay Transit Center: This potential station would serve the Caltrain shared-use option as a downtown terminal station, or
- 4th and King (Caltrain): This potential station would serve the Caltrain shared-use four-track option as a downtown terminal station.

##### *San Francisco International Airport (SFO):*

- Millbrae: This potential station would serve as a connection with San Francisco International Airport.

##### *Mid-Peninsula:*

- Redwood City (Caltrain): This potential station would provide accessibility and serve the populations between San Jose and San Francisco, or
- Palo Alto (Caltrain): This potential station would provide accessibility and serve the populations between San Jose and San Francisco.

**Oakland to San Jose:** The alignment alternatives and station location options in this segment carried forward for further consideration are illustrated in Figure 1 and discussed below:

- Niles Subdivision Line to I-880 (Niles/I-880): From Oakland, this alignment would travel south following the UPRR's Niles Subdivision Line ("Hayward Line") and then transition to I-880. Station options include Oakland, Oakland Airport, and Union City or Fremont.

The alignment would be at grade along the Niles Subdivision Line and on an aerial structure in the median of I-880. (The I-880 HST portion would mostly be on an aerial configuration from San Jose to Fremont.) This option would require the construction of columns and footings in the wide median of I-880 and a tunnel under the lake in Fremont Central Park.

#### Station Locations Carried Forward

##### *Oakland:*

- West Oakland: This potential station would serve Oakland the Niles/I-880 Line, or
- 12th Street/City Center: This potential station would serve Oakland from the Niles/I-880 Line.

##### *Oakland International Airport:*

- Coliseum BART Station: This potential station would serve the Oakland Airport from the Niles/I-880 Line.

##### *Southern Alameda County:*

- Union City (BART): This potential station would serve the population centers between Oakland and San Jose from the Niles/ I-880 Line, or
- Union City (Shinn): This potential station would serve the population centers between Oakland and San Jose from the Niles/ I-880 Line, or
- Fremont (Warm Springs): This potential station would serve the population centers between Oakland and San Jose from the Niles/ I-880 Line.



**San Jose to Central Valley:** The alignment alternatives and station location options in this segment carried forward for further consideration are illustrated in Figure 1 and discussed below.

- Pacheco Pass Options:

- Caltrain/Gilroy/Henry Miller Avenue: This alignment would extend south along the Caltrain/UPRR rail corridor through the Pacheco Pass and then the San Joaquin Valley. Station options include the existing San Jose (Diridon) Station, and Gilroy (near the existing Caltrain Station), or Morgan Hill (near the existing Caltrain Station).
- Caltrain/Gilroy/GEA North/Merced: This alignment would extend south along the Caltrain/UPRR rail corridor through the Pacheco Pass, pass through the northern portion of the Grasslands Ecological Area (GEA) and then across the San Joaquin Valley. Station options include the existing San Jose (Diridon) Station, and Morgan Hill (near the existing Caltrain Station) or Gilroy (near the existing Caltrain Station).

Station Locations Carried Forward

*San Jose:*

- San Jose (Diridon): This potential station would serve all alignment options (Caltrain/Monterey Highway rights-of-way) out of San Jose.

*South Santa Clara County:*

- Morgan Hill (Caltrain): This potential station would serve all the Pacheco Pass alignment options, or
- Gilroy (Caltrain): This potential station would serve all the Pacheco Pass alignment options.

**East Bay to Central Valley:** The alignment alternatives and station location options in this segment carried forward for further consideration are illustrated in Figure 1 and discussed below.

- Altamont Pass:

- UPRR: This alignment would extend east via a relatively direct routing (mostly in tunnel) between Niles Junction and I-680 then utilize the UPRR alignment through Pleasanton and Livermore before transitioning to the I-580 corridor through the Altamont Pass to Tracy. Station options include the Pleasanton (Bernal/I-680) Station, or Livermore (near downtown), or Livermore (Greenville Rd.), and Tracy (downtown) or Tracy (ACE).
- I-580: This alignment would extend east along the I-580/BART corridor through the Altamont Pass and then to Tracy and the San Joaquin Valley. Station options include the Pleasanton (BART) Station, or Livermore (I-580), or Livermore (Greenville Rd.), and Tracy (downtown) or Tracy (ACE).

- I-580/UPRR. This alignment would extend east via a relatively direct routing (mostly in tunnel) between Niles Junction and I-680 then utilize the UPRR alignment through Pleasanton before transitioning I-580 corridor through Livermore and the Altamont Pass to Tracy. Station options include the Pleasanton (Bernal/I-680) Station, or Livermore (I-580), or Livermore (Greenville Rd.), and Tracy (downtown) or Tracy (ACE).
- SR-84/South of Livermore. This alignment would extend east near the UPRR alignment through Niles Canyon then follow the SR-84 corridor south of Pleasanton and Livermore and continue east (south of Livermore) to the Patterson Pass corridor and to Tracy. Station options include the Pleasanton (I-680/SR-84) Station, or Livermore (South Isabel), and Tracy (downtown) or Tracy (ACE).
- SR-84/I-580/UPRR. This alignment would extend east near the UPRR alignment through Niles Canyon then follow the SR-84 corridor south of Pleasanton and Livermore and turn north to connect to the I-580/UPRR Alignment through the Altamont Pass to Tracy. Station options include the Pleasanton (I-680/SR-84) Station, or Livermore (Greenville), and Tracy (downtown) or Tracy (ACE).

#### Station Locations Carried Forward

##### *Tri-Valley:*

- Pleasanton (I-680/Bernal Road): This potential station would serve the Altamont I-580/UPRR alignment option and the Altamont UPRR alignment, or
- Pleasanton (I-680/SR-84): This potential station would serve the Altamont SR-84/South of Livermore alignment option or the SR-84/I-580/UPRR alignment, or
- Pleasanton (BART): This potential station would serve the Altamont I-580 alignment option, or
- Livermore (Downtown): This potential station would serve the Altamont UPRR alignment option, or
- Livermore (I-580): This potential station would serve the Altamont I-580 alignment option and the Altamont I-580/UPRR alignment, or
- Livermore (Isabel): This potential station would serve the Altamont SR-84/South of Livermore alignment option and the Altamont SR-84/I-580/UPRR alignment, or
- Livermore (Greenville Road/UPRR): This potential station would serve the Altamont UPRR alignment option, or
- Livermore (Greenville Road/I-580): This potential station would serve the Altamont I-580 alignment option and the Altamont I-580/UPRR alignment, or
- Livermore (Greenville Road/SR-84/UPRR): This potential station would serve the Altamont SR-84/I-580/UPRR.

##### *Tracy:*

- Tracy (Downtown): This potential station would serve all Altamont Pass alignment options, or
- Tracy (ACE): This potential station would serve all Altamont Pass alignment options.

**San Francisco Bay Crossings:** The alignment alternatives carried forward in this segment for further consideration are illustrated in Figure 1 and discussed below.

- New Transbay Tube: This alignment would connect the Oakland (West Oakland or 12<sup>th</sup> Street City Center) and San Francisco (Transbay Transit Center or 4<sup>th</sup> and King) HST stations via a new transbay tube. This alignment could serve either Altamont Pass or Pacheco Pass alignment options.
- Dumbarton Rail Crossing: This alignment would serve Altamont Pass alignment options and link the East Bay to the Peninsula in the vicinity of the existing Dumbarton Rail Bridge. Design options for this alignment include use of an improved Dumbarton Rail Bridge (low level), a new high-level bridge, and a new transbay tube.

**Central Valley Alignment:** The alignment alternatives and station location options in this segment carried forward for further consideration are illustrated in Figure 1 and discussed below.

- BNSF Rail Line: This alignment would connect with either the Altamont or Pacheco Pass alignment options. This north-south alignment would link the Bay Area to Central Valley population centers, Sacramento, and Southern California. Potential stations within the study area are at Modesto (Briggsmore) and Merced (Downtown, and Castle ARB).
- UPRR Line: This alignment would connect with either the Altamont or Pacheco Pass alignment options. This north-south alignment would link the Bay Area to Central Valley population centers, Sacramento, and Southern California. Potential stations within the study area are at Modesto (Downtown) and Merced (Downtown, and Castle ARB).

#### Station Locations Carried Forward

##### *Modesto:*

- Downtown Modesto: This potential station would serve Altamont Pass and Pacheco Pass alignment options using the UPRR alignment, or
- Briggsmore (Amtrak): This potential station would serve Altamont Pass and Pacheco Pass alignment options using the BNSF alignment.

##### *Merced:*

- Downtown Merced: This potential station would serve all Altamont Pass and Pacheco Pass alignment options, or
- Castle ARB: This potential station would serve all Altamont Pass and Pacheco Pass alignment options.

### **Previously Considered Alternative Corridor Options Reconsidered and Rejected**

The following HST Alternative alignment and station options were considered but rejected from further consideration in the Program EIR/EIS for the Proposed California HST System (Authority and FRA, 2005). The reasons for elimination of each of the corridor options evaluated in the

previous studies are categorically summarized below in Table 2 and further described in Appendix A. The reasons for elimination of these conceptual alternatives were described in the Final Program EIR/EIS for the Proposed California HST System (November 2005) and are further supported by the scoping comments received for this Bay Area to Central Valley Program EIR/EIS.

**Table 2**  
**Bay Area to Merced: High-Speed Train Alternative Alignment and**  
**Station Options Considered and Eliminated**

Alignment or Station	Reason for Elimination							Environmental Concerns
	Construction	Incompatibility	Right-of-Way	Connectivity/ Accessibility	Revenue/ Ridership	Alignment Eliminated*	Environment	
San Francisco to San Jose								
US-101 Alignment (exclusive guideway)	P	S	P				P	Visual, land use (right-of-way acquisition)
Caltrain Corridor (exclusive guideway)	P	P	P				P	Visual, land use (right-of-way acquisition), cultural resources
Interstate 280 Alignment	P		P				P	Visual, land use (right-of-way acquisition)
Station Locations								
Millbrae–San Francisco Airport (US-101)						P		
Redwood City (US-101)						P		
Santa Clara (Caltrain)					P			Station area would be served by Diridon Station only 3 miles away
Oakland to San Jose								
Mulford Line	P	P	P				P	Visual, land use, wetlands, parklands impacts
I-880 (Note: only Oakland to Fremont portion to be eliminated)	P		P					
Former WPRR Rail Line through Niles Junction to Mulford Line (WPRR/Niles/Mulford alignment)	P						P	Wetlands, parklands impacts
Hayward Line via tunnel to Mulford Line (Hayward/Tunnel/Mulford alignment)	P	S	P				P	Wetlands, parklands, land use, seismic constraints
Former WPRR Rail Line via tunnel to Mulford Line (WPRR/Tunnel/Mulford alignment)	P	S	P				P	Wetlands, parklands, land use, seismic constraints
Former WPRR Rail Line to Hayward Line to I-880 (WPRR/Hayward/I-880)	P							

Alignment or Station	Reason for Elimination							Environmental Concerns
	Construction	Incompatibility	Right-of-Way	Connectivity/ Accessibility	Revenue/ Ridership	Alignment Eliminated*	Environment	
Former WPRR ( Warm Springs to San Jose)	P		P					
<i>Station Locations</i>								
Lake Merritt		P		P				
Jack London Square	P			P				
I-880 Hegenberger						P		
Coliseum BART (WPRR)						P		
Mowry Avenue	P					P		
<b>San Jose to Central Valley</b>								
Merced Southern alignment (Central Valley Portion of San Jose-Merced section for Diablo Range Direct options)							P	San Luis National Wildlife Refuge impacts
Direct Tunnel Alignment (Northern or Southern Connection to Merced)	P						S	Seismic constraints
Diablo Range Direct Options (Northern Option and options through Henry Coe State Park)	P						P	Parklands, habitat fragmentation, high value aquatic resources, visual and noise
Caltrain/Morgan Hill/Foothill/Pacheco Pass Alignment	P	P		P			P	Visual, land use
Caltrain/Morgan Hill/East US-101/Pacheco Pass Alignment		P		P				
Caltrain/Morgan Hill/Pacheco Pass Alignment	P		P					
<i>Station Locations</i>								
Morgan Hill (Foothills)				P		P		
Morgan Hill (East of US-101)				P		P		
Los Banos					P		P	Water resources, T&E species, growth related impacts



Alignment or Station	Reason for Elimination							Environmental Concerns
	Construction	Incompatibility	Right-of-Way	Connectivity/ Accessibility	Revenue/ Ridership	Alignment Eliminated*	Environment	
Central Valley Alignments								
West of SR-99				P			P	Farmlands, water resources, floodplains, severance impacts
East of SR-99				P			P	Farmlands, water resources, floodplains, severance impacts
BART = San Francisco Bay Area Rapid Transit District.								
Definitions:								
Reason: Primary (P) and secondary (S) reasons for elimination.								
Construction: Engineering and construction complexity, initial and/or recurring costs that would render the project impracticable and logistical constraints.								
Environment: High potential for considerable impacts to natural resources, including waters, streams, floodplains, wetlands, and habitat of threatened or endangered species that would fail to meet project objectives.								
Incompatibility: Incompatibility with current or planned local land use as defined in local plans that would fail to meet project objectives.								
Right-of-Way: Lack of available rights-of-way or extensive right-of-way needs would result in high acquisition costs and/or delays that would render the project impracticable.								
Connectivity/Accessibility: Limited connectivity with other transportation modes (aviation, highway and/or transit systems) would impair the service quality, could reduce ridership of the HST system, and would fail to meet the project purpose.								
Ridership/Revenue: The alignment/station would result in longer trip times and/or have suboptimal operating characteristics and would have low ridership and revenue and would fail to meet the project purpose.								
Alignment Eliminated: Station or connection eliminated because the connecting alignment option was eliminated.								
* Alignment Eliminated column only applies to station locations. If an alignment is eliminated, a specific station location may no longer be necessary.								

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## APPENDIX A

**San Francisco to San Jose:** The alignment alternatives and station options eliminated from further consideration in this segment are described below.

- **US-101 Alignment:** From San Francisco (Transbay Terminal or 4th and King Terminal Station), this alignment would follow south along the US-101 freeway alignment to San Jose and be on an exclusive guideway in the US-101 corridor.

This exclusive guideway alignment would have major construction issues involving the construction of an aerial guideway adjacent to and above an active existing freeway facility while maintaining freeway traffic. Limited right-of-way in this corridor would require the extensive purchase of additional right-of-way and nearly exclusive use of an aerial structure between San Francisco and San Jose. In San Francisco, major new tunnel construction would be required.

The US-101 alignment would require many sections of high-level structures to pass over existing overpasses and connector ramps, resulting in high construction costs and constructability issues that would make this option impracticable. This alignment would also require relocating and maintaining freeway access and capacity during construction. The aerial portions would introduce a major new visual element along the US-101 corridor that would have visual impacts (intrusion/shade/shadow) on the residential portions for this alignment. In addition, the freeway has substandard features (e.g., medians and shoulders) in many places, and it is assumed that any room that might be available for HST facilities likely would be used by Caltrans to upgrade the freeway in these areas. Construction of the tunnel in San Francisco from the Transbay Terminal site to 17th Street would be difficult because most of the tunnel would need to be constructed using compressed air techniques in very soft Bay-fill ground.

- **Caltrain Corridor (Exclusive Guideway):** From San Francisco (Transbay Terminal or 4th and King Terminal Station), this alignment would follow south along the Caltrain rail alignment to San Jose. This alignment would be on an exclusive guideway within the Caltrain corridor.

An exclusive guideway alignment would be impracticable in this area because it would have major construction issues and high capital costs involving the construction of an aerial guideway adjacent to and above an active existing transportation facility, while maintaining rail traffic. It would require the extensive purchase of additional right-of-way and nearly exclusive use of an aerial structure between San Francisco and San Jose.

The aerial portions of this alignment would introduce a new visual element along the Caltrain corridor that would have visual impacts (intrusion/shade/shadow) on the residential portions of this alignment. For the Caltrain exclusive guideway option, introduction of the elevated structure (for the high-speed tracks and stations) would also have adverse impacts on the suburban town centers along the Caltrain corridor (San Mateo, San Carlos, Redwood City, Menlo Park, Palo Alto, and Mountain View). Although the structure would generally be in a commercial area in these centers, it would represent a physical barrier for land use and urban design. Construction of the tunnel in San Francisco from the Transbay Terminal site to 17th Street would be particularly difficult because most of the tunnel would need to be constructed using

compressed air techniques in very soft Bay-fill ground. Although the Caltrain exclusive guideway alignment would provide faster potential travel times than any of the other alignment options in this section, this alternative would have the most impacts on cultural resources and would be the least compatible with the existing and planned development on the Peninsula. Samtrans has formally commented that this alternative would not be compatible with its existing and planned Caltrain services and would not be feasible in its existing right-of-way.

- I-280 Alignment (Exclusive Guideway): From San Francisco (Transbay Terminal or 4th and King Terminal Station), this alignment would follow south along the I-280 freeway alignment to San Jose and be on an exclusive guideway in the I-280 corridor.

This exclusive guideway alignment would have major construction issues involving the construction of an aerial guideway adjacent to and above an active existing freeway facility while maintaining freeway traffic. Limited right-of-way in this corridor would require the extensive purchase of additional right-of-way and nearly exclusive use of an aerial structure between San Francisco and San Jose. The portion within the City and County of San Francisco is fully developed, and connecting the alignment to Diridon Station in San Jose would require a guideway passing through developed portions of downtown San Jose. These areas would require considerable property acquisition.

The I-280 alignment would require many sections of high-level structures to pass over existing overpasses and connector ramps (in particular at interchanges with routes 17 (580), 85, and 92), resulting in high construction costs and constructability issues that would make this option impracticable. This alignment would also require relocating and maintaining freeway access and capacity during construction. The aerial portions would introduce a major new visual element along the I-280 corridor that would have visual impacts (intrusion/shade/shadow) on the residential portions, nature preserves and scenic areas for this alignment. In addition, the freeway has substandard features (e.g., medians and shoulders) in many places, and it is assumed that any room that might be available for HST facilities likely would be used by Caltrans to upgrade the freeway in these areas. The considerable earthwork and retaining walls needed through Palo Alto and Woodside would have potentially significant impacts to nature preserves. The I-280 corridor would not allow a convenient connection to San Francisco International Airport from the south – the alignment would have to leave the freeway corridor and pass through Hillsborough and Burlingame to provide access to the airport. For these reasons the I-280 corridor is not considered to be a practicable alternative for HST service between San Jose and San Francisco.

Station Locations: The following station locations were considered and eliminated because they were located on alignments that were eliminated.

- Millbrae–San Francisco International Airport (US-101).
- Redwood City (US-101).
- Santa Clara: A potential link to San Jose International Airport would be at Santa Clara less than three miles north of the potential downtown San Jose station. Because the downtown San Jose (Diridon) station site would provide sufficient

connectivity to San Jose airport for the foreseeable future the Authority has determined that the HST system would have no HST station at Santa Clara.

**Oakland to San Jose:** The alignment alternatives and station options eliminated from further consideration in this segment are described below.

- Mulford Line: From Oakland, this alignment would follow south along Union Pacific Railroad's (UPRR's) entire Mulford Line.

Using the most northern portion of the Mulford Line would be impracticable, having high capital costs and construction issues, because it is an existing narrow rail line whose use would need to be expanded to accommodate a proposed HST system. It would create substantial environmental impacts and have considerable potential for effects on social and economic resources and minority populations while being the least compatible with existing and planned development. This alignment would require a portion of the UPRR corridor (that is generally 60 ft or 18.3 km wide) for aerial structure foundations and for an aerial easement over the tracks that would result in high visual impacts. In addition, a 50-ft (15.3-km) right-of-way strip would be needed from the residential, commercial, and light industrial areas to the east of the alignment.

The southern portion of this alignment goes through the Don Edwards National Wildlife Refuge, which would result in high potential for environmental impacts (hydrology and water resources, biology and wetlands, visual impacts, and Section 4(f) and 6(f) parkland impacts).

- I-880: From Oakland, this alignment would follow I-880 south to San Jose.<sup>2</sup>

The I-880 alignment would require acquisition of considerable right-of-way in the more northern area to be able to expand the highway sufficiently to allow for high-speed tracks in the median. The I-880 alignment would be mostly an aerial configuration requiring construction of footings within the highway right-of-way and lane closures during construction. This likely would require off-peak construction, which is time consuming and costly. Where the highway is narrow (Oakland to Fremont), adding high-speed rail would require full median widening and would present right-of-way issues similar to major highway reconstruction (demolition of existing adjacent property, new noise walls, demolition of existing noise walls, construction of new highway lanes, and maintenance of traffic). This alternative would have high capital costs and substantial right-of-way constraints, making it impracticable.

- Former WPRR Rail Line through Niles Junction to Mulford Line (WPRR/Niles/Mulford alignment): From Oakland, this alignment would follow the former WPRR Rail Line onto the UPRR's Hayward Line, to UPRR's Niles Line, and then UPRR's Mulford Line.

This alternative would be nearly entirely on an aerial structure that would create substantial visual impact. The WPRR alignment would have major construction issues making it impracticable, including rearrangement of BART foundations to allow

<sup>2</sup> Only the Oakland to Fremont segment of the I-880 option would be eliminated since the Fremont to San Jose portion is part of the Hayward/I-880 option carried forward for further evaluation.

for the high-speed alignment to pass from one side of BART to the other. In contrast, the proposed alignment along the UPRR Hayward Line would be at grade and would follow the existing freight and commuter railroad.

The southern portion of this alignment goes through the Don Edwards National Wildlife Refuge, which would result in high potential for environmental impacts (hydrology and water resources, biology and wetlands, visual impacts, and Section 4(f) and 6(f) parkland impacts).

- Hayward Line via tunnel to Mulford Line (Hayward/Tunnel/Mulford alignment): From Oakland, this alignment would follow south along UPRR's Hayward Line (Niles Subdivision) to a tunnel leading to UPRR's Mulford Line.

The tunnel alternatives in Fremont have high projected costs, and the tunnel section would result in considerable right-of-way constraints, making this option impracticable. The purpose of a tunnel would be to improve travel times and eliminate tight curves. However, eliminating tight curves would result in tunnel alignments through the City of Fremont that do not follow under existing transportation rights-of-way. This alternative would not be compatible with the existing development and would have considerable seismic constraints.

The southern portion of this alignment goes through the Don Edwards National Wildlife Refuge, which would result in high potential for environmental impacts (hydrology and water resources, biology and wetlands, visual impacts, and Section 4(f) and 6(f) parkland impacts).

- Former WPRR Rail Line via tunnel to Mulford Line (WPRR/Tunnel/Mulford alignment): From Oakland, this alignment would follow the former WPRR rail line, transitioning to UPRR's Hayward Line, then to a tunnel leading to UPRR's Mulford Line.

The tunnel alternatives in Fremont have high projected costs, and the tunnel section would result in considerable right-of-way constraints making this option impracticable. The purpose of a tunnel would be to improve travel times and eliminate tight curves. However, eliminating tight curves would result in tunnel alignments through the City of Fremont that would not follow under existing transportation right-of-way. This alternative would not be compatible with the existing development and also has considerable seismic constraints.

- Hayward Branch through Niles to Mulford Line (Hayward Line/Niles/Mulford Alignment): From Oakland, this alignment would travel south along UPRR's Hayward Line to UPRR's Niles Line and then onto UPRR's Mulford Line.

This alignment goes through the Don Edwards National Wildlife Refuge, which would result in high potential for environmental impacts (hydrology and water resources, biology and wetlands, visual impacts, and Section 4(f) and 6(f) parkland impacts). This option would also require tight curves that would greatly limit operational speeds between Union City and Newark – with express travel times at least 6 minutes longer than the Hayward Line/I-880 option.

- Former Western Pacific Railroad (WPRR) Rail Line to Hayward Line to I-880 (WPRR alignment/Hayward/I-880): From Oakland, this alignment would follow the UPRR



(former WPRR) rail line transition to UPRR's Hayward Line and then transition to I-880.

This alignment option would be nearly entirely on an aerial structure that would create substantial visual impacts. The WPRR alignment would have considerable construction issues making it impracticable, including the rearrangement of San Francisco Bay Area Rapid Transit (BART) foundations to allow for the high-speed alignment to pass from one side of BART to the other. In contrast, a proposed alignment along the UPRR Hayward Line (Niles Subdivision) would be at grade and would follow the existing freight and commuter railroad.

- Former WPRR Rail Line (Warm Springs to San Jose): The former WPRR has been sold to Santa Clara Valley Transportation Authority (VTA) for the BART link between Warm Springs to San Jose. Purchasing the ROW necessary to widen the corridor sufficiently for all planned uses and providing full grade separation would result in significant impacts to industrial and residential properties and would not be practicable.

Station Locations: The following station locations were considered and eliminated in the Oakland to San Jose section.

- Oakland Terminus Stations
  - Lake Merritt: The Lake Merritt Station would result in a high level of potential adverse effects in residential areas. Residential uses would be proximate to this potential station site, whereas land uses adjacent to the potential Jack London Square and the City Center station sites are more commercial in nature. The Lake Merritt Station and alignment would require construction of a tunnel or subway through the campus of Laney College adjacent to the BART alignment. The Lake Merritt alternative does not meet the program objectives since it would not be compatible with existing development, and would not provide sufficient connectivity and accessibility to serve the East Bay.
  - Jack London Square: The Jack London Square Station and alignment leading to and from it would be in bored tunnels in the bay mud underneath the Embarcadero and the active UPRR tracks. Relocating the railroad even temporarily is probably not an option. A cut-and-cover access would need to be constructed within the Amtrak parking lot and a concourse would need to be excavated over the bored tunnels. This station option would have the most considerable geologic challenges and soils constraints of the Oakland terminus alternatives. A terminus HST station at Jack London Square would be difficult to construct and would be the most costly alternative to serve Oakland. Although the Jack London Square location would serve a thriving commercial center and could provide a direct link to Amtrak, this terminus would not provide a connection with BART. This option is impracticable because of logistical constraints and would not meet program objectives because it would not connect with BART to provide accessibility and connectivity for the East Bay.
- Oakland Airport/Coliseum Stations
  - I-880 Hegenberger: This potential station site would only serve the I-880 (entire segment) alignment that has been eliminated from further investigation.

- South Alameda County Stations

- Mowry Avenue: This potential station site would only serve the I-880 (entire segment) alignment that has been eliminated from further investigation.

**San Jose to Merced:** The alignment alternatives and station options eliminated from further consideration in this segment are described below.

- Diablo Range Direct Options:

- Merced Southern Alignment (Central Valley portion): This alignment would extend from the eastern base of the Diablo Range through the San Joaquin Valley to Merced (at a Merced Municipal Airport Station).

The southern variation of the Diablo Range direct alignment has been eliminated from further investigation for Diablo Range Direct options because of potential environmental impacts. The southern alignment option would pass through approximately 4.4 mi (7 km) of sensitive wetlands, including the San Luis National Wildlife Refuge. It would also pass through floodplains, farmlands of statewide importance, and sensitive habitats. Diablo Range Direct options would use an alignment north of the San Luis National Wildlife Refuge that would minimize environmental impact.

- Direct Tunnel Alignment (northern or southern connection to Merced): This alignment would have a station at the existing San Jose (Diridon) Station heading south on the Caltrain/UPRR just north of I-85, turning east into a long (31 mi [49.6 km]) tunnel to San Joaquin Valley to Merced (near Castle Air Force Base [AFB]).

The direct tunnel alignment option would cross three active and potentially active fault areas in a tunnel including the Ortigalita fault, the southern extension of the Greenville fault trend, and the Calaveras fault zone. The direct tunnel alignment is likely to cost at least \$3 billion more than the minimize tunnel option that would use a 3.5% gradient to minimize tunneling. This higher cost would be due largely to the long tunnel and the high unit cost per mile associated with tunnels that exceed 6 mi (9 km) in length. The direct tunnel concept would involve construction of a tunnel that would be among the longest in the world (31 mi [49.6 km]) through mixed soil and geology types. The results of the Authority's technical tunnel conference indicated that, while not impossible, a tunnel of this length in California would be extremely expensive to construct, operate, and maintain, and would therefore be impracticable.

- Diablo Range Direct Alignments (Northern Tunnel, Minimize Tunnel, & Tunnel Under Park): These alignment options would have a station at the existing San Jose (Diridon) Station heading south on the Caltrain/UPRR, just north of I-85 turning east through the Diablo Range to the San Joaquin Valley to reach Merced using the northern alignment (near Castle ARB). Three alignments were developed to better define this general corridor: the northern tunnel, minimize tunnel, and tunnel under park options.

HST alignments through (or under) Henry Coe State Park (which includes the Orestimba State Wilderness Preserve) would have greater potential

environmental impacts than alignment options that would avoid the park. Alignments through Henry Coe State Park would have the highest impacts to Section 4(f) and 6(f) Resources (both long-term and construction impacts). In addition, the considerable amount of public and agency input in regards to these alignment options has been overwhelmingly opposed to any construction through Henry Coe State Park.

The Northern Tunnel alignment would have high potential impacts to the natural environment, including potential impacts to high value aquatic resources, habitat fragmentation, visual and noise impacts. Construction of an alignment through this remote area would bisect sensitive eco-systems in an alignment that does not follow an existing transportation corridor across the Mt. Hamilton/Diablo Range. The USEPA's scoping comments recommend eliminating from further analysis "any alternatives that impact the designated aquatic resources of national importance in Del Puerto Creek, Salado Creek, Crow Creek, and Orestimba Creek watersheds in the Diablo Range". Any alignment through the Diablo Range north of Henry Coe State Park will impact these resources. The USEPA also stated, "Considering the high value aquatic resources and the potential for large scale habitat fragmentation, EPA continues to believe that the Diablo Direct alignments do not appear to exhibit characteristics of the least damaging practicable alternative (LEDPA), the only alternative that can be permitted under the CWA Section 404 regulations (40 CFR 230.10 (a) and (c))." Scoping comments from the California Department of State Parks state, "Habitat degradation and wildlife corridor fragmentation between SPS units and other open space lands, such as The Nature Conservancy's Mount Hamilton Project conservation lands, are two of our highest concerns". US Department of the Interior Fish and Wildlife Service scoping comments state, "The portion of the Diablo Range to be impacted by these proposed crossings has been recognized for its important natural resources" and "There are significant natural resource concerns related to the proposed Northern Mountain crossings. The Diablo Range alignments would result in substantial direct and indirect impacts to federally listed wildlife species in the region, including the endangered kit fox, the threatened California red-legged frog, the threatened bay checkerspot butterfly, and the threatened California tiger salamander, as well as various threatened and endangered plant species." In addition, the considerable amount of public input and input from organizations and other agencies in regards to this portion of the Diablo Range north of Henry Coe State Park has been overwhelmingly opposed to any construction through this area because of potential environmental impacts to this remote and environmentally sensitive area.

- Pacheco Pass Options:
  - Caltrain/Morgan Hill/Foothill/Pacheco Pass Alignment: This alignment would extend south along the Caltrain/UPRR rail corridor, traveling south in the foothills east of US-101 through the Pacheco Pass and the San Joaquin Valley.

The Caltrain/Morgan Hill/Foothill/Pacheco Pass alignment is the least costly of all alignments in this section, primarily due to less tunneling and its shorter length compared to the other Pacheco Pass alignments. However, this alignment would have potentially substantial impacts on sensitive habitat (through the foothills)

and would have high visual impacts. This new transportation corridor through the foothills would not be compatible with existing and planned development; would result in potentially severe impacts on the existing suburban, rural, and open space areas in the foothills; and would provide minimal connectivity and accessibility. It would not link to the Caltrain commuter rail service south of San Jose.

- Caltrain/Morgan Hill/East 101/Pacheco Pass Alignment: This alignment would extend south along the Caltrain/UPRR rail corridor, transitioning to south US-101 east through the Pacheco Pass and the San Joaquin Valley.

The Caltrain/Morgan Hill/East 101/Pacheco Pass alignment option is similar to the Caltrain/Morgan Hill/Pacheco Pass option, with the exception that it would use the US-101 corridor to connect to the Caltrain corridor north of Morgan Hill as opposed to south of Morgan Hill. This option would not meet basic program objectives because it would have poor compatibility with development and insufficient connectivity and accessibility. This option would not provide a direct link to the Caltrain commuter rail service south of San Jose. This alignment would pass through the longest length of floodplain of all the Pacheco Pass options.

- Morgan Hill/Caltrain/Pacheco Pass Alignment: This alignment would extend south along the Caltrain/UPRR rail corridor through the Pacheco Pass and San Joaquin Valley. Station options include the existing San Jose (Diridon) Station, and Morgan Hill (near the existing Caltrain Station).

Although an alignment bypassing Gilroy to the east might have positive attributes, there is no existing transportation corridor or other useable undeveloped potential right-of-way linking the Pacheco Pass directly to Morgan Hill through the Santa Clara Valley east of the Caltrain alignment. Any alignment through this area would result in considerable property impacts with the development of a new HST corridor.

Station Locations: The following station locations were considered and eliminated in the San Jose to Merced section.

- Morgan Hill (Foothills): This potential station site would only serve the Pacheco Pass/Foothills/Morgan Hill/Caltrain alternative that has been eliminated from further investigation. This option would have poor connectivity and accessibility and not meet the basic program objectives.
- Morgan Hill (East of 101): This potential station would only serve the Pacheco Pass/East of 101/Caltrain alternative that has been eliminated from further investigation. This option would have poor connectivity and accessibility and not meet the basic program objectives.
- Los Banos: A HST station at Los Banos (Western Merced County) should not be pursued in subsequent environmental reviews because of low intercity ridership projections for this site, limited connectivity and accessibility, and potential impacts to water resources and threatened and endangered species. Although the City of Los Banos supports the Pacheco Pass alignment with a potential station at Los Banos, considerable public and agency opposition has been expressed about a potential Los Banos HST station because of its perceived potential to result in growth

related impacts. This station option (as well as the Visalia/Hanford option) has low ridership potential compared to other potential station locations investigated by the Authority. In 2020, this station is forecast to serve a population of only about 88,000 (forecast to only have between 155,000 and 190,000 annual total intercity boardings and alightings by 2020). Excluding this station is expected to slightly reduce the capital costs of the HST system and reduce potential environmental impacts at Los Banos.

**Central Valley Alignments:** The alignment alternatives and station options eliminated from further consideration in this segment are described below.

- West of State Route 99: Alignment options creating a “new” transportation corridor west of SR-99 through undeveloped land.

Creating a new transportation corridor to the west of SR-99 would require cutting through mostly agricultural lands 2-5 miles to the west of SR-99. These alignments would result in increased potential impacts on agricultural lands and natural resources (including wetlands, water resources, floodplains and habitat) and would have high severance impacts through the Central Valley. Comments received from federal, state, and local agencies as well as the public as part of the Authority's and FRA's certified statewide HST Program EIR/EIS support the concept of locating the HST system along an existing rail corridor to the greatest extent possible through the Central Valley. These same entities were generally opposed to the creation of a new transportation corridor in undeveloped portions of the Central Valley. Alignment options to the west of SR-99 (and any potential outlying stations associated with those alignments) should be eliminated from further consideration because they would not avoid or substantially reduce potential environmental impacts and because they would not meet basic project purpose and objectives.

- East of State Route 99: Alignment options creating a “new” transportation corridor east of SR-99 through undeveloped land.

Creating a new transportation corridor to the east of SR-99 would require cutting through mostly agricultural lands 2-5 miles to the east of SR-99. These alignments would result in increased potential impacts on agricultural lands and natural resources (including wetlands, water resources, floodplains and habitat) and would have high severance impacts through the Central Valley. Comments received from federal, state, and local agencies as well as the public as part of the Authority's and FRA's certified statewide HST Program EIR/EIS support the concept of locating the HST system along an existing rail corridor to the greatest extent possible through the Central Valley. These same entities were generally opposed to the creation of a new transportation corridor in undeveloped portions of the Central Valley. Alignment options to the east of SR-99 (and any potential outlying stations associated with those alignments) should be eliminated from further consideration because they would not avoid or substantially reduce potential environmental impacts and because they would not meet basic project purpose and objectives.